Phase I Project Summary

Firm: Intelligent Automation, Inc.
Contract Number: NNX12CD54P
Project Title: UAS Demand Generation and Airspace Performance Impact Prediction

Identification and Significance of Innovation: (Limit 200 words or 2,000 characters whichever is less)
The key innovation of this effort is the development of a method to specify *Uninhabited Aerial System* (UAS) flights given the various missions they intend to fly, coupled with the development of *data warehouse* that stores these flights so that they can be accessed by aviation researchers worldwide for many types of analysis. The FAA and NASA maintain standard data sets for traditional piloted vehicles (commercial and general aviation flights), including past and future predictions, there is an absence of similar data for the UAS community. Consequently, this repository is of immense technical value to the entire aviation community since it can be used by researchers to investigate multiple "what-if" scenarios of introducing UAS flights into the NAS.

Technical Objectives and Work Plan: (Limit 200 words or 2,000 characters whichever is less)
The primary objective of Phase 1 was to develop an approach for developing future UAS demand that generates credible flight schedules that can be used by the aviation community to conduct multiple UAS mission analyses. The specific objectives of Phase 1 include:

Objective 1. Develop a method for modeling the demand of UAS aircraft, given the various missions they are expected to fly.

Objective 2. Develop a method that translates the inchoate demand information into specific flight schedules, generating multiple flight schedules when key parameters are uncertain.

Objective 3. Develop a method for creating multiple "views" of the generated flight demand, so an analyst can tailor a flight data set to their individual needs.

The work plan involved four tasks to achieve the aforementioned objectives:

1. Mission profile generation for civilian uses of UAS.
2. Demand generation with modifications to the TSAM software to handle UAS missions.
3. Development of a UAS flight data warehouse, in which flight data sets from different mission profiles were stored, and can be accessed by analysts.
4. Example analyses demonstrating the utility of the approach through an experiment designed to highlight the impact of UAS on a region of the NAS.

Technical Accomplishments: (Limit 200 words or 2,000 characters whichever is less)
An approach to model and generate future demand for UAS missions and deposit these data sets in a data warehouse for easy access by analysts to study impact of UAS flights on NAS. Three sample missions for selected to demonstrate this approach. One of the missions (UAS cargo transport) consisted of a socio-economic component to be modeled, which was accomplished by expanding the capabilities of the Transportation System Analysis Model (TSAM) software developed and maintained by Virginia Tech. Demand data sets for the other two UAS missions were developed in consultation with domain experts. Flight simulations were conducted using the Airspace Concept Evaluation System (ACES) software with the UAS demand data sets as input. NAS performance was measured in terms of flight delays and loss of separation (LOS) events, which were compared to a baseline simulation comprising CONUS flight traffic for a day. Analysis of the results indicated only a marginal increase in flight delays but a significant

increase in LOS events in the simulations involving UAS flights, which was hypothesized to be a result of an increase in en route congestion due to UAS flights.

NASA Application(s): (Limit 100 words or 1,000 characters whichever is less)
A matured approach to produce UAS flight demand data for use by aviation analysts worldwide. Further, the approach produces not only more UAS demand sets, but also credible demand sets that analysts deem reliable and useful. Another potential application is the use of the activity-based modeling approach to the generation of commercial service, which is an area that has consistently been poorly forecast by the aviation community in the last decade. The activity-based approach may provide a better understanding of the future dynamics of the traveling public, and hence future demand generation may be improved because of it.

Non-NASA Commercial Application(s): (Limit 200 words or 2,000 characters whichever is less)
Worldwide aviation analysts interested in studying the effects of UAS' aircraft, either in a fast-time or human-in-the-loop simulation, are potential customers. In addition, aviation authorities, as well as aircraft manufacturers and airlines, would be interested in any advances in demand modeling that arise as a result of the combination of the activity-oriented modeling and the traditional socioeconomic approaches. This combination could possibly prove to be a path-breaking technology that may be beneficial to all stakeholders.

It is estimated that the market size for a successful and credible UAS demand generation system will include all aviation authorities as well as aviation analysts worldwide, the UAS manufacturing industry, and to some extent, commercial airlines and freight operators. Such demand data sets will allow these stakeholders to plan their operations with a focus on UAS aircraft even before they are actually flown in the public airspace in large numbers. Planning for such events, whether it be in the governmental domain (i.e. the FAA) or the industrial domain (i.e. the UAS industry), is a valuable activity for these stakeholders.

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